

Tomaspis appears to be a tropical and subtropical genus only. I never met with it in any of my collecting expeditions in the Transvaal. Delagoa Bay at present is its recorded southern limit; but probably it may be found in Durban, where much is still to be done, apart from Lepidoptera, and where other species only previously known in Mozambique have been discovered.

XII.—*A Contribution to the Biology of the Social Wasps of Brazil.* By H. VON IHERING*.

It is nowadays very difficult and—particularly in cases where special attention has to be paid to the literature of extra-European countries—barely possible to guarantee full cognizance of all that has been written upon a biological theme. Consequently something may have escaped my notice even in respect of the subject about to be discussed, although, on the whole, the statements in the following paper will probably be new to my scientific colleagues.

On studying the various special memoirs or the descriptions in handbooks &c., we invariably find that the account of the life of the social wasps is altogether European, based exclusively upon the facts to be observed in Europe and in the holarctic region in general. In order to make myself intelligible upon this point, let me briefly refer to what is generally known. The social life of the European wasps is eminently adapted to the harsh climate of Europe. There are in Europe, so far as is at present known, no wasp-communities that hibernate regularly, though even as to this I must nevertheless be allowed to entertain doubts with regard to the extreme south of Europe, especially with reference to *Polistes*. In autumn the community separates, the workers and males perish, while the fertilized females alone hibernate and commence the foundation of a new colony in the spring.

How utterly different is the case here! Even *Polistes*, the single genus of social wasps common to Europe and Brazil, behaves somewhat differently. Here, too, it is the rule for the community to be dissolved in winter; but nevertheless in July, therefore in mid-winter, we meet with colonies of *Polistes versicolor*, Fabr., still surviving and continuing to

* Translated by E. E. Austen from the 'Zoologischer Anzeiger,' Bd. xix. no. 516 (November 2, 1896), pp. 449-453.

exist in an almost inactive condition with a diminished number of individuals: it is true that this is not the case in Rio Grande do Sul, though it certainly occurs in São Paulo. In Rio Grande do Sul it was a very remarkable sight to watch *Polistes* (females and workers) at the commencement of winter seeking out human habitations, in order to search for suitable hiding-places in which to hibernate. Even thus many perish, but in spring I have repeatedly seen on freshly-begun nests a female carrying on building-operations already in company with workers. Whether in such cases remnants of a colony have come together to build a new home, or whether the hibernated female has accepted the assistance of chosen hibernated workers, I am unable to say.

In the case of *Polybia* and its allies the influence of winter is much less noticeable than in *Polistes*. *Polybia scutellaris*, White, still hibernates even in Rio Grande do Sul. The very solid prickly envelope of the large nest doubtless affords a good protection against the weather. Moreover this very species collects honey freely and in relatively large quantities. It is amassed in pretty irregular fashion in the lower cells, especially at the edge of the combs, but it nevertheless induces boys, and also adults with a *penchant* for sweets, to destroy the nest. I have seen many nests inhabited for a long period. Here in S. Paulo, too, I have made the same observation upon the *paulista* variety of this wasp, which will be referred to later on. It is consequently not a matter for surprise when one notices these wasps again in the open during exceptionally fine weather in the middle of winter.

Another new observation upon *Polybia* is the fact that it swarms. Whether a fertilized female *Polybia* is ever capable of commencing a nest alone, as is, indeed, still probable, is a point which future study must decide: at any rate, it is not the rule for it to do so. I have very often observed the commencement of new nests of *Polybia*; the task was always undertaken by a swarm. A closely packed cluster of *Polybia scutellaris*, of the size of a large orange or larger, settles on some spot or other, often by no means a suitable one, without, however, at once deciding to begin to build.

Not infrequently is the spot changed several times before work commences. Then, however, it proceeds astonishingly fast, so that in from two to three weeks a nest is built containing from four to five combs. At the same time, however, the whole of the attention is in the first place devoted exclusively to nest-building, so that one finds charming new nests with from three to four combs in which there is not yet a single cell that has received even an egg. In the case of

Polybia scutellaris it is not easy to discover the males and females. How many times have I not examined the entire contents of the nest without finding any! In Rio Grande do Sul I several times found females (twelve to fourteen) in the nest of *P. scutellaris*, as well as males in considerably larger numbers. The females are not or scarcely larger than the workers; but the wings, which show a slight brownish sheen, afford a better means of recognition.

Moreover in this respect the nests exhibit very different conditions, according to the number of the workers. I once examined a rather small nest with only three combs, which nevertheless already contained brood. The number of the workers in this case amounted to only 126. An observation may here also be alluded to which is opposed to what was seen by Janet in connexion with *Vespa*. The insects brought in by *Polybia scutellaris* are never chewed up into food-balls, but are carried in whole, sometimes more, sometimes less mutilated, though the wings are always removed. Termites and house-flies constitute the principal quarry, though the latter are seldom captured alive, but are usually carried off when dead or in a half-dead condition.

In the case also of *Polybia sericea*, Oliv., I have frequently seen a new nest commenced in a precisely similar fashion. Once upon a fresh spring morning I observed a swarm that evidently had hibernated without a nest. The wasps, still quite stiff, crawled out from a low bush. The nest had probably been destroyed by inclement weather or by enemies. Among the latter I allude especially to the large "Lagarto" lizard (*Tupinambis teguexin*, L.), which is particularly dangerous to the nests of *Nectarinia mellifica*, Sauss., which are always placed pretty low down and are rich in honey. With reference to this it may be remarked that I also met with honey in the nests of *Polybia sericea*.

In the case of the above-named *Nectarinia* I once observed a nest in autumn which contained about an equal number of males and workers. A large proportion of the latter contained eggs, but one had to regard them as workers on account of the rudimentary receptaculum seminis. It is probable that here also drones are produced from the eggs of workers, and this very circumstance would afford an explanation of the exceptionally large number in the nest referred to.

In connexion with the differences which have been described in the mode of life of the communities are those which we find in the structure of the nests. In this respect, as regards variety and finish of the edifices, no other region of the earth can compare with Brazil; for out of the whole of the wasps

of the Old-World *Vespa* is the only one that builds a complicated nest surrounded by an envelope: all the rest in their style of architecture more or less resemble *Polistes*. In eastern South America, on the other hand, what wealth and variety of structural types, what elegance and marvellous artistic skill! While referring the reader to Saussure's classical monograph, I would here draw attention only to what is new among my observations.

It is well-known that the nest of *Mischocyttarus* is very similar in construction to that of *Polistes*, differing only in the longer central pedicle; but it was to me an altogether surprising and unexpected discovery to find that there are also species of *Polybia* whose nests are indistinguishable from those of *Polistes*. The species in question are *Polybia vicina*, Sauss., and *P. ignobilis*, Halid. All the other members of the genus, even *Polybia atra*, Sauss., build nests with concentric envelopes, so that when the nest is enlarged the last and most recent envelope is always used as a base for the new combs. It may appear at first sight to be a matter of no special importance that within the limits of a large genus a portion of the species should differ in the structure of their nests; but the subject is nevertheless a much more complicated one, since with these differences others in the mode of life of the communities are directly connected. In the one group we have the foundation by a fertilized female of what is usually a community existing for one year, in the other long-lived colonies founded by the formation of swarms, as in the case of bees.

I am bound to admit that I regard these species of *Polybia* which live after the manner of *Polistes* as representing a distinct genus. It is probably not customary to utilize biological considerations for the foundation of genera, but perhaps even in this case closer investigation will demonstrate the morphological basis for the separation inferred on biological grounds.

According to their mode of life, or, say, the formation of communities, the social wasps of South America may therefore be divided into two groups:—

(1) **Summer communities**, or such as last for one year, founded in spring by fertilized females which have hibernated: *Polistes*, *Mischocyttarus*, and *Pseudopolybia* (a name which I adopt for *Polybia*-like wasps that construct nests after the manner of *Polistes*).

(2) **Perennial communities**, founded by swarms after the fashion of bee-colonies: *Polybia*, *Apoica*, *Tatua*, *Synoeca*, *Chartergus*, *Nectarinia*.

The Old-World genera not mentioned in this list all belong to the first group. Divers species of *Polybia* are known from tropical Asia, but I know nothing about their life-history.

In conclusion, I would add a remark as to the genital apparatus, in which the closest agreement exists in all the genera of social wasps that I have investigated. The number of testicular tubes is always the same as that of those of the ovary, and this number is invariably three on each side, as is also the case in the solitary wasps examined.

In the strongest contrast to this condition, that I have proved to exist in *Polistes*, *Mischocyttarus*, *Nectarinia*, *Polybia*, and *Chartergus*, is what we have recently learnt from Bordas *, in amends for previous inexact statements. According to this author the number of testicular tubes in *Vespa* is from two hundred to three hundred. How large the number of the ovarian tubes really is (earlier accounts speak of six or more) must remain uncertain in default of fresh examination. *Vespa* consequently presents a strong contrast to the rest of the social wasps, and in this respect stands in the same relation to them as that in which the Apidæ stand to the Andrenidæ or Megachilidæ, since in the former there are three hundred testicular tubes, in the latter three. It appears that for the Hymenoptera this number *three* represents the primitive condition, and therefore *Apis* and *Vespa* are aberrant types. As to the anatomy of the social wasps of Africa and India we as yet know nothing. In these cases the work accomplished for the South-American genera has still to be done. Then, and not until then, will it be possible to ascertain the relation of *Belonogaster*, *Icaria*, &c. to the rest of the Vespidæ. Probably it will then be found that *Vespa* cannot be included in the same family as the other genera of social wasps. The true Vespidæ, including *Vespa*, would then have a very large number of testicular tubes; the rest of the Polybiidæ would exhibit three of these structures in each testis. It is probable that upon closer investigation yet other differences will be added in other organs or in the larvæ, and to point out the necessity for such studies is precisely the object of this exposition.

São Paulo, Brazil,
July 23, 1896.

* Bordas, "Appareil genital mâle des Hyménoptères," Annales des Sciences natur. vii. sér. tom. xx., 1895.